



# **Biomechanical Analysis of T2 Exercise**



**NASA-Johnson Space Center**

## **Exercise Physiology and Countermeasures Project/SK**

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## **Background**

- Crewmembers regularly perform treadmill exercise on the ISS
- With the implementation of T2 on ISS, there is now the capacity to obtain ground reaction force (GRF) data
- GRF data combined with video motion data allows biomechanical analyses to occur that generate joint torque estimates from exercise conditions
- Knowledge of how speed and load influence joint torque will provide quantitative information on which exercise prescriptions can be based.

# **Objectives**

Determine the joint kinematics, ground reaction forces, and joint kinetics associated with treadmill exercise on the ISS.

This study will:

- 1) Determine if specific exercise speed and harness load combinations are superior to others in exercise benefit.
- 2) Aid in the design of exercise prescriptions that will be most beneficial in maintaining crewmember health.

# **Experiment Design**

<b>Preflight</b>	<b>In-Flight</b>	<b>Postflight</b>
<p>1 training &amp; test session*</p> <p>Any time prior to flight: 1.25 hours (Experiment Briefing/Training + Test Session)</p>	<p>Approx FD 30 and every 30 days thereafter during mission**</p> <p>**Up to 6 in-flight sessions</p>	<p>NONE</p> <p>*If preflight data collection not possible, BDC could occur after landing</p>

# **Session Description - Preflight**

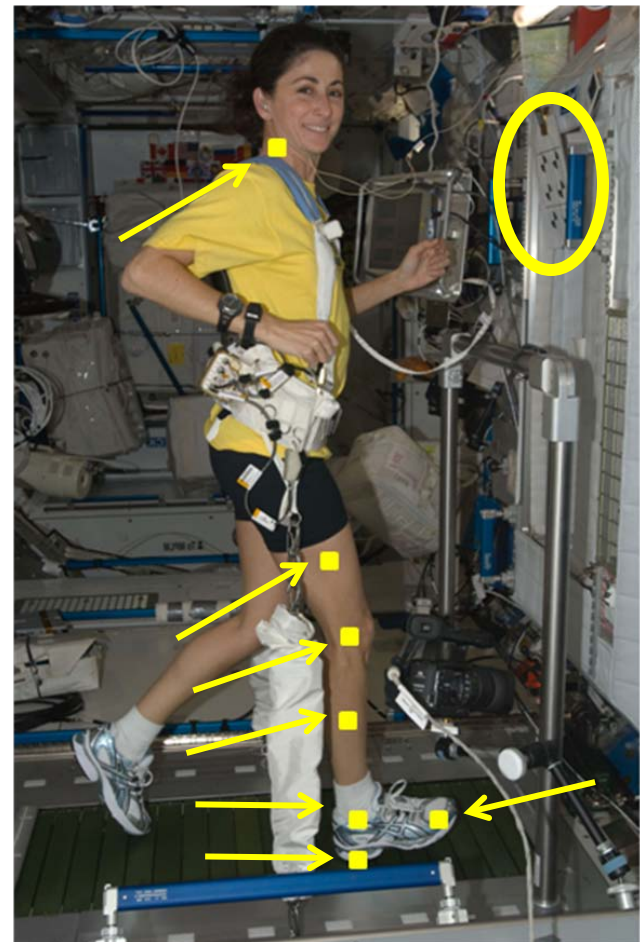
- **Data Collection**
  - **B261, Rm 138 – Biomechanics Lab**
  - **Markers placed on leg and neck**
  - **Motion capture data and force data collected**
  - **Exercise**
    - **Walk at 1.5 mph for 1 min**
    - **Walk at 2.0 mph for 1 min**
      - **Repeat for each .5 mph increment up to 12 mph, but can stop at any time**
    - **Rest at any time**

# **Experiment Training**

<b><u>Session Title</u></b>	<b><u>Schedule</u></b>	<b><u>Duration</u></b>	<b><u>No. Repetitions</u></b>
BDC/Training	Any time preflight	75 min	1

# **Session Description - Inflight**

- **Data Collection**
  - **Camcorder View**
    - Positioned to view entire right side of body, including T2
  - **Marker Placement**
    - Right leg and side of neck
  - **Camcorder calibration**
    - Hold sheet in view of camcorder near area of thigh motion for 5-10 secs



## Possible Risks or Discomforts

Study is classified as reasonable risk

**Potential Hazard: Muscle cramping may occur during or after the exercise tests. Muscle soreness may also occur 24 to 48 hours after exercise.**

### Protection to Minimize Risks:

- Subjects will be encouraged to warm-up prior to testing by performing a protocol that includes low intensity motion and flexibility exercises. After exercise testing is completed, the subjects will be encouraged to perform a cool-down that includes light stretching.



## **Possible Risks or Discomforts**

### **Potential Hazard: Muscle/joint injury**

#### **Protection to Minimize Risks:**

- Subjects will perform pre-testing warm-up and stretching.
- A familiarization session will be performed to instruct the subjects in proper exercise technique.

## **Possible Risks or Discomforts**

**Potential Hazard: Mild skin irritation from tape and/or motion capture markers**

**Protection to Minimize Risks:**

- To prevent skin irritation, motion capture markers will be attached to cloth and non-adhesive prewrap to reduce the need to attach markers directly to the skin. Any attachment directly to the skin will occur using hypoallergenic adhesive.

## **Study Relevance**

- 1) First assessment of the biomechanics of locomotion on the ISS treadmill and the associated joint motions and torques during exercise.
- 2) Will allow us to determine if specific speed, loading, and speed-loading conditions are optimal for health maintenance and improvement.